

Watershed Management in Drinking Water for Emergency: A Case of Lake Biwa - Yodo River System

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1. Background

Lake Biwa - Yodo River water system is located in the middle west part of Japan and supports urban life and activities as one of the main water source for 14 million consumers in the Kansai area (Fig. 1). The water system is characterized by urbanization and developed industry in upstream area, at the same time, much use of domestic water in downstream area. This means the water is being reused so highly from upstream to downstream that there exist many kinds of risk factors to water safety.

Drinking water supply utilities taking water from the river organize "Yodo River Water Quality Committee" for integrated source water quality management to cope quickly and systematically with source accidents. This paper describes outline of the Committee and its source monitoring for emergency.

2. Outline of Yodo River Water Quality Committee

Fig. 2 shows yearly changes in raw water quality at Kunijima water treatment plant (WTP) of Osaka City, one of the largest utilities. Since the quality rapidly deteriorated due to increased domestic and industrial wastewaters in 1960s, downstream utilities were forced to take countermeasures for these problems. The utilities concluded that cooperative approach for integrated source quality management was the best way and established Yodo River Water Quality Committee in 1965, which is currently composed of ten utilities (Osaka Prefectural -, Osaka Municipal -, Moriguchi City -, Neyagawa City -, Hirakata City -, Suita City -, Amagasaki City -, Itami City -, Nishinomiya City - waterworks and Hanshin Water Supply Authority) (Pic. 1). Since then, the Committee has engaged in various activities for resource conservation including;

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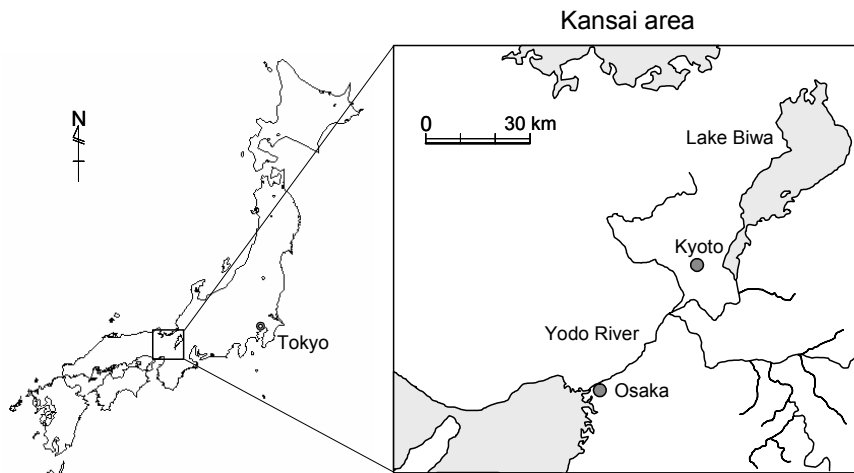


Fig. 1 Outline of Lake Biwa - Yodo River water system

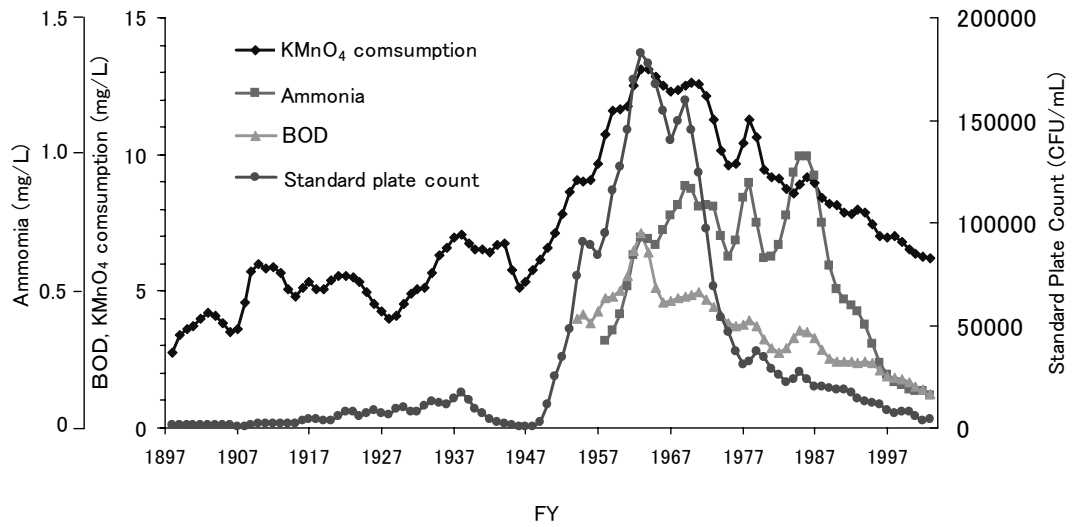


Fig. 2 Yearly changes in water quality of Yodo River



Pic. 1 Board Meeting of Yodo River Water Quality Committee

- Regular monitoring of source quality
- Research and investigation for source quality management
- Advocating activities for pollution control
- Awareness raising for resource conservation
- Establishment of information networks for emergency control

3. Water Source Monitoring for Emergency

(1) Information Networks for Emergency Control

In case of source accident, river administrator provides the Committee with information reported from the finder. Then the Committee informs all the members of the accident according to emergency information networks rules (Fig. 3).

Fig. 4 shows changes in the number of source accidents. The number has been increasing since 1990 after brief decline at around 1980. Severe accidents which directly affect waterworks has been decreasing, on the other hand, the ratio of oil spill accidents has been increasing in recent years. The Committee has periodically appealed to administrative bodies to supervise the causative facilities, and achieved successful results.

An oil spill accident in October 2003 provides a good example. The accident occurred at one of tributaries of Yodo River and affected downstream utilities. One of WTPs was forced to stop water intake for four hours and six of WTPs had to reduce water intake, absorb oil, or use powdered activated carbon to cope with the spilled oil. Quick circulation of information followed by proper response to the accident prevented finished water from being contaminated. After that, four affected utilities claimed compensation from the causative facility that the Committee identified.

(2) Organizing Watershed Data

Differences in the arrival time of contaminants from accident spot to intake points are useful when accidents happen. The Committee developed "Arrival time display system in Yodo River" based on observed time considering the effect of river shape and estuary barrage. The Committee also created factories' database in the basin named "Environmental map" (Fig. 5) containing their locations and harmful chemicals used to quickly respond to source accidents. The map can numerically display contamination risk by harmful chemicals in the whole area utilizing the stored data.

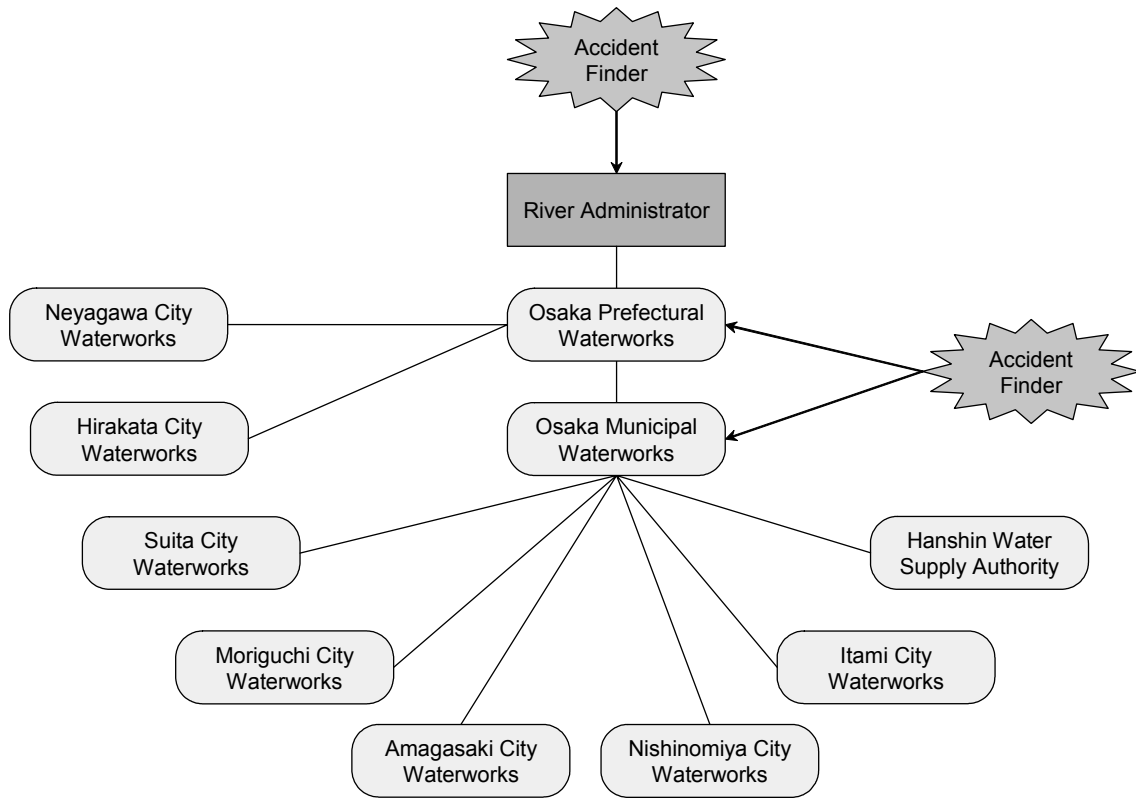


Fig. 3 Information networks for emergency control

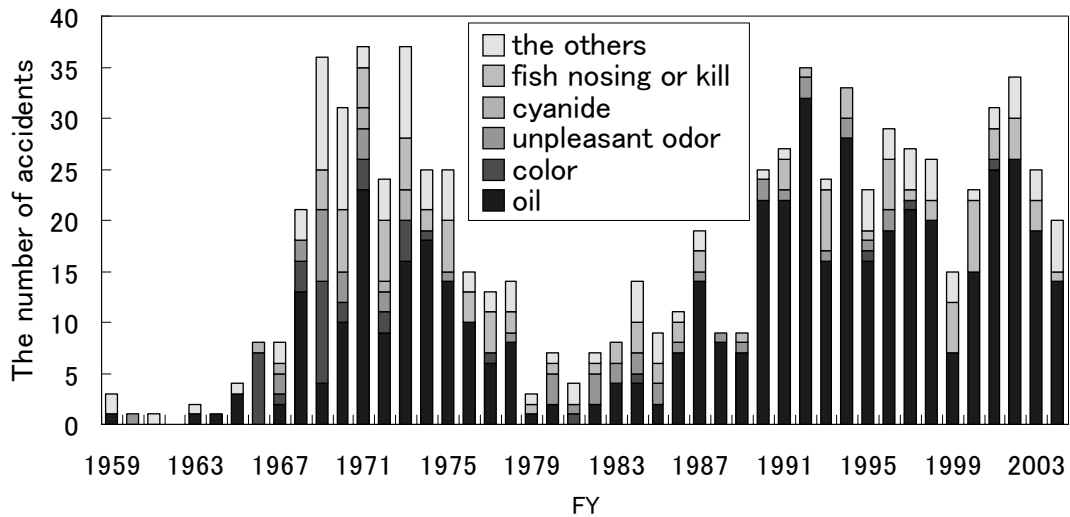


Fig. 4 The number of water source accidents in Lake Biwa – Yodo River water system

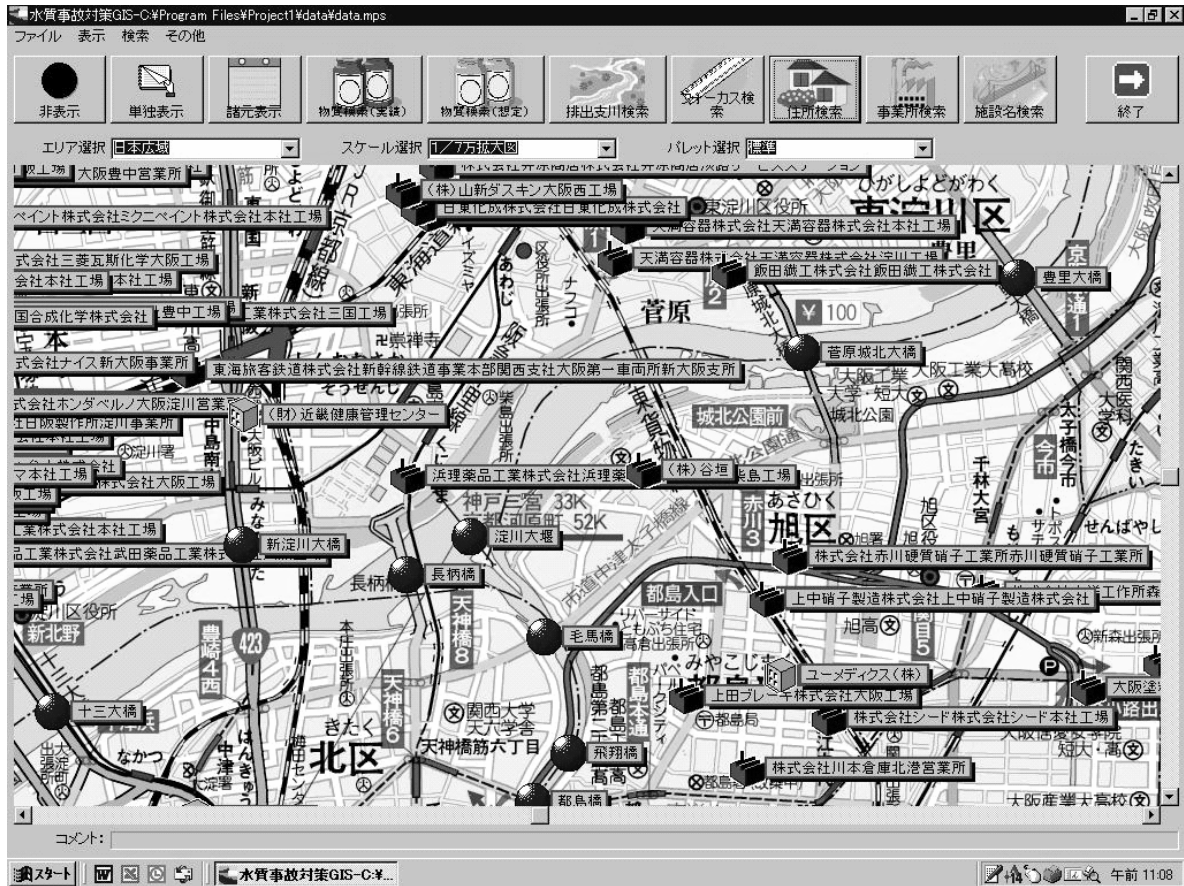


Fig. 5 Part of environmental map in Yodo River basin

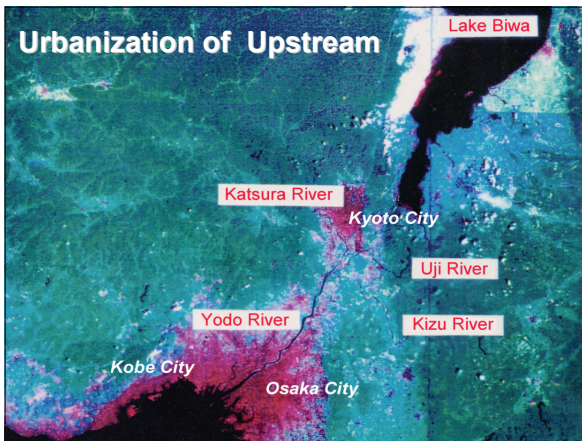
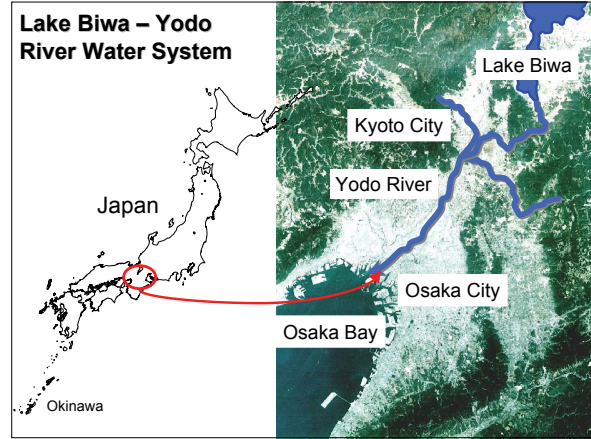
4. Summary

Delay in the response to accidents in the source may cause serious damages in the social life, since the systems of waterworks being consisted of series of facilities from source to consumers' tap and the systems are not free from vulnerability. In order to ensure water safety, it is important to detect source accidents as quickly as possible and then respond to them properly. The Yodo River Water Quality Committee, a group of downstream water utilities of Yodo River being exposed to the high risk of accidents, jointly monitors water source and engages in resource conservation activities. These efforts have been successfully assuring safety of drinking water so far.

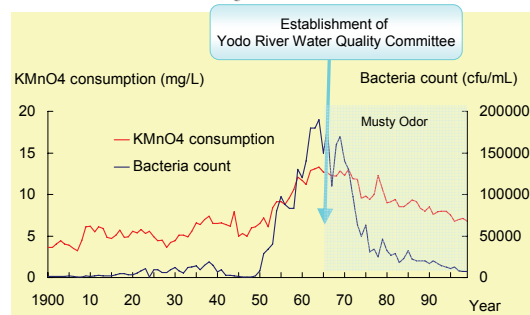
There are other efforts in regard to watershed management. Review Panel on Water Cycle Dysfunction Risk in Emergency, a panel established by government ministries, is discussing cross-sectoral measures to avoid or reduce water quality risk in case of earthquake, whose target area includes Yodo River basin. In addition, Kansai Waterworks Association consisted of eight major utilities in the Kansai area has jointly been studying on "Kansai version of Water Safety Plan". The developing process will include scientific evaluation on risk factors about their characteristics and risk levels. The goal is to contribute to planning of source quality management and drinking water treatment.

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Changes in Raw Water Quality at Kunijima WTP



Establishment of Yodo River Water Quality Committee

- Why organized ?
 - Urbanization and industrial development in upstream area
 - Deterioration of water quality in Yodo River
- When established ?
 - 1965
- What purpose ?
 - Cooperative approach for integrated source water quality management

Members

- Osaka Prefectural -
- Osaka Municipal -
- Moriguchi City -
- Neyagawa City -
- Hirakata City -
- Suita City -
- Amagasaki City -
- Itami City -
- Nishinomiya City Waterworks
- Hanshin Water Supply Authority

Total Capacity (plan)
7.2 million m³/d
Served population
11 million

Board Meeting



Activities



Regular Monitoring of Source Quality

- Monthly monitoring conducted with cooperative system
- 20 Monitoring points
- Over 160 of monitoring Items
- Results summarized as annual reports



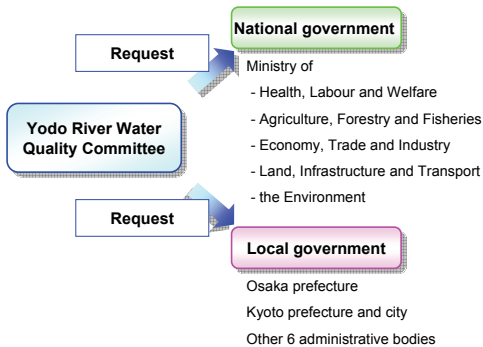
Research and Investigation

- Several working groups for special task urgently needed

Assignment

- Musty odor at Lake Biwa
- Precursors of trihalomethanes and agricultural chemicals in the water source
- Development of useful tools for quick response to water source accidents

Advocating Activities for Pollution Control



Awareness Raising for Water Resource Conservation

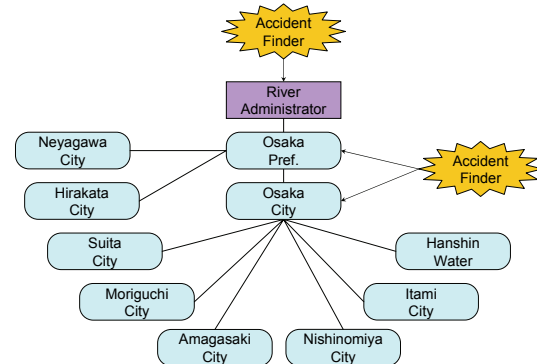
- Posters and brochures
- Annual lecture meeting



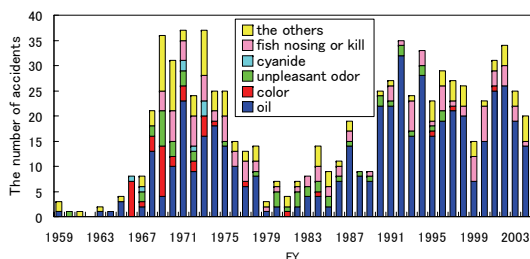
Water Source Monitoring for Emergency

- **Information-sharing**
 - Monitoring of source quality
 - Source accident
 - Research and investigation
 - Risk factors
- Control of pollutant source
 - Advocating activities
 - Awareness raising

Information Networks for Emergency Control



The Number of Water Source Accidents in Lake Biwa -Yodo River Water System

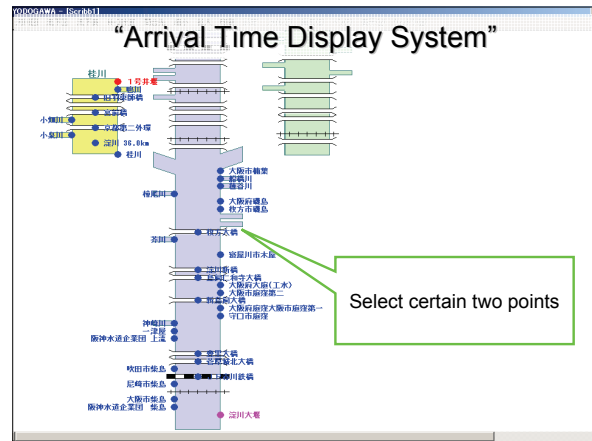


Case with Oil Spill Accident

- Diesel oil spill from a gas station to a tributary stream
- 6 WTPs suffered damage
 - Oil removal, PAC, increase of ozone dose, reduction of water intake
 - One WTP stopped taking water for 4 hours.
- No contamination of finished water
- Identification of causative facility
- Claim for compensation

“Arrival Time Display System” and “Environmental Map” in Yodo River

- To respond to source accidents quickly and properly



“Arrival Time Display System”

流下時間の比較表 (桂川→深川)		平均流速			
スタート 地点から の距離km	橋造物名称	桂川→深川(m/s)			
		30→147	30→180	21→147	21→180
		時間:分	時間:分	時間:分	時間:分
0.00	1号井堰	0:00	0:00	0:00	0:00
9.90	桂川	4:21	4:44		
34.60	深川大壩	54:09	38:57	54:32	39:20

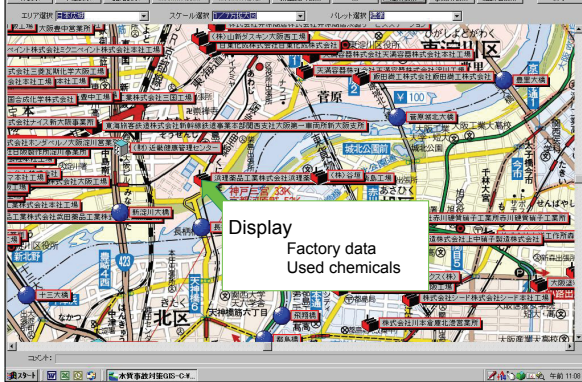
The least time required between the points and average flow rate is displayed.

“Environmental Map”

Information system combining factory database and GIS

Number of factory data	6,500
Area on the system	25 cities, wards and counties in the Yodo River water system
Type of industry	31 types
Data item	15 items (address, chemicals used, volume of discharge etc.)
Software	Exclusive Mapping Soft (ProAtlas)
Additional function	Reference to the factories' information, output of the file
Search function	Address, chemicals used and point of discharge

“Environmental Map”



Effects of Cooperative Activities

- Reduction in cost concerning water conservation
- Prompt countermeasure for unexpected pollution
- Powerful advocating activities to national and local government

Summary

- It is important to detect resource accidents as quickly as possible and respond to them properly.
- Yodo River Water Quality Committee jointly monitors water source and engages in resource conservation activities.
- To assure safety of drinking water

Other Efforts of Watershed Management in Drinking Water

- Review Panel on Water Cycle Dysfunction Risk in Emergency
 - Established by government ministries
 - To avoid or reduce water quality risk in case of earthquake
- Kansai version of Water Safety Plan
 - Kansai Waterworks Association (8 major utilities)
 - To contribute to planning of source quality management and drinking water treatment